

Radiological Information for Farmers and Growers

From a brochure published by
The Virginia Department of Emergency Management
10501 Trade Court
Richmond, VA 23236

Preface

This information applies to all areas of the Commonwealth of Virginia. It is designed to provide information for farmers and growers on the probable and potential effects of radiation on farming operations. This guide will also be useful to processors and distributors of products from within an affected area or accident site. If there is an accident which may affect your farming operation, you will be warned by the Virginia Emergency Broadcast System (EBS) on your local radio or television station that a radiological emergency exists in your area. If you are warned, you may be advised to do the following:

- Arrange for the safety of you and your family.
- Shelter all farm animals, especially dairy cattle, and feed and water livestock from stored feed and protected water.
- Bring feed into building, or cover it if outdoors.
- Store as much water as possible for livestock. Cover wells, rain barrels and tanks.
- Delay grazing of animals on contaminated pasture.
- Wear protective clothing (such as that worn during pesticide applications) when working outdoors during the first few days following a release of radioactivity.

Governmental agencies will conduct assessments of land and crop damages and will advise and assist you on farm activities and product usage and distribution following an accident.

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Introduction

This information is intended to help farmers better understand the effects of radioactive contamination on plants, soil, water and animals, and the basic needs and care of animals should a radiological accident occur within the Commonwealth of Virginia. The information contained within this pamphlet applies to communities near nuclear power stations, shipyards, research reactor sites and nuclear fuel plants. This information also applies to communities, which may be affected by a transportation accident involving radioactive or nuclear materials on one of our major roads or highways. Information is shared on what you may be asked to do if an incident occurs causing an area to be exposed to radioactive contamination.

In the event of an emergency, your first concern should be ensuring the safety of you and your family. State officials using the EBS will notify the public of necessary protective steps. If the accident is of such severity that it will also affect farming in your area, instructions for farmers' needs will also be issued over EBS. This information will provide you with an explanation of the actions that you may be advised to take to protect farm animals and farm products.

Comprehensive emergency plans have been prepared cooperatively by local government and state emergency management officials to advise you should the need arise. For example, in the case of a nuclear power station accident, this includes a 10-mile area around the plant site. For the agricultural industry, plans have been made to include a 50-mile zone from the plant, with the emphasis on protecting dairy products and crops. Teams of trained personnel have been organized to implement emergency procedures and assist all residents during an emergency. See Appendix 1 for a listing of local governments within 50 miles of a nuclear power station.

Radiation and Our Environment

Radiation is energy in the form of small particles or rays that are emitted from a radiation source. The source may be a machine that produces radiation, such as a microwave oven, or it may be an unstable atom that, because of its instability, emits radiation. Unstable atoms that emit ionizing radiation are referred to as "radioactive."

Radioactive materials and radiation occur in our everyday environment. For example, X-rays and other kinds of radiation are used for medical purposes. The earth's crust contains uranium, radium, thorium and other radioactive materials. Cosmic radiation from outer space and the sun penetrates the earth's atmosphere. The elements of hydrogen, potassium and carbon contain both radioactive and non-radioactive atoms. These naturally occurring radioactive elements are in the air we breathe, the food we eat and the water we drink. As a result, every person has radioactive materials in his or her body.

Add to these radiation sources, those of nuclear weapons tests and certain industrial plant processes, and we realize that there are several sources releasing small quantities of radioactive materials into the environment.

Radiation Exposure and Health

The big question is, if too much radiation is harmful, how much exposure can we accept before we start worrying about our health? Radiation harm to the human body, animals and plants depends on several factors. The radiation dose level and the time period over which it is received are major factors as to degree of harm. The unit used to measure this dose is called a "rem." Radiation can cause chemical changes that may damage or kill cells if the amount of energy absorbed is large enough. This

is the principle behind radiation treatment for cancer. Exposure to radiation may increase a person's risk of developing cancer.

Potential Sources of Radiological Emergencies

This brochure applies to peacetime emergencies resulting from fixed nuclear facility incidents (including commercial and military nuclear power reactors); transportation incidents; and other incidents, e.g., nuclear powered satellite reentry. Sabotage and terrorism are not treated as separate types of incidents; rather, they are considered a complicating dimension of the incident types noted.

Specifically, the following fixed nuclear facilities are potential sources of radiological emergencies in Virginia:

- North Anna Power Station, near the town of Mineral, Virginia;
- Surry Power Station, on Hog Island in Surry County, Virginia;
- Calvert Cliffs Nuclear Power Plant, near Lusby, Maryland;
- Naval and commercial shipyards, Hampton Roads area;
- Commercial and naval nuclear fuels plants and research reactors, near Lynchburg; and
- Nuclear research reactors at the University of Virginia, Charlottesville.

Action Guides for a Radiological Accident

The principal means by which the public may be exposed to radiation following an accident are:

- Externally from radioactive materials that are released into the air;
- Internally from breathing airborne radioactive particles or eating food contaminated by radioactive elements.

The federal government has set guidelines for radiation exposure to the public for nuclear power plant accidents and incidents at test and research reactors, fuel processing plants and other facilities using or producing large quantities of radioactive material. These guidelines recommend actions when (1) the total projected dose to the whole body from external radiation exceeds 500 millirem or, (2) the total projected dose to the thyroid from internal radiation exceeds 1,500 millirem. Precautionary measures may be recommended at radiation levels below the limits mentioned above or even before any radioactivity is released from an accident site.

The primary means of protection from radiation are (1) sheltering, (2) increasing distance and (3) reducing exposure time. The amount of radioactive particles and gases one is exposed to will depend greatly upon the size of the release and wind conditions.

Contamination

Contamination is the presence of radioactive particles in unwanted locations. Anything can become contaminated: people, animals, water, food, plants, soil, farming equipment, etc. Contamination is caused by radioactive particles lying on the surface of an object. In the case of people and animals, internal contamination can result from breathing radioactive particles in the air, drinking radioactive water or eating radioactive food.

Therefore, it is necessary to take special precautions with farm animals to prevent or minimize contamination.

Outer skin surfaces can be decontaminated through washing, but radioactive material collected inside the body may result in a long-term exposure and is, therefore, of greater concern.

Care should be taken to prevent or minimize the radioactive particles that are taken into the body or allowed to collect on your skin or clothing.

In an Emergency, Who Will Provide Advice

This information provides general advice as to precautions, preparations and actions you can take. However, in a radiological emergency, the Virginia Department of Emergency Services in cooperation with the Virginia Departments of Health, Agriculture and Consumer Services and the Virginia Cooperative Extension Service will monitor and broadcast radiation levels, dangers and recommended actions based on information gathered by radiation monitoring teams. Federal and state agencies will conduct damage assessments in potentially affected areas and will inform farmers, growers and producers of any actions, which should be undertaken. The general public will receive this information over the EBS.

Protecting Farm Animals and Products

Suggested actions to protect dairy animals and livestock from radiological contamination follow. The first priority is the safety of you and your family. It is unlikely that animals will suffer from contamination that will cause death or permanent injury, but radioactivity ingested by dairy animals can contaminate milk and milk products. Therefore, dairy animals should be provided with shelter, stored feed and protected water supplies before precautions are taken for other farm animals. If there is sufficient shelter, feed and water available, move other livestock indoors and place them on stored feed and protected water supply. The major concern for protecting dairy animals from contamination is to protect the milk and other dairy products produced for human consumption. See Appendix 2 for basic livestock requirements.

Water from a covered well, tank, cistern or from a freely running spring is best. To prevent contamination from radioactive particles, do not add water to covered tanks unless the water is from a protected well or spring. Use all the water originally present in the tanks first.

Water in an exposed pond would be contaminated but, usually, the level of contamination would decrease rapidly. Such water could be used for surface irrigation. It could also be used to wash off farm buildings and unsheltered livestock. Surface water should be safe within a few days after emissions. The surface waters in ponds and rivers would tend to be safer sooner if there is no rain. Otherwise, if possible, obtain drinking water for livestock from another source.

Feed

Covered feeds are the safest feeds. Radioactive particles are like dust or dirt; a cover will prevent contamination from coming in contact or mixing with the feed.

Grain stored in a permanent bin, hay in a barn and ensilage in a covered silo can be considered protected. They can be used as feed for your dairy animals and livestock. A haystack in an open field can be protected with a tarpaulin or similar covering.

Remain alert to emergency broadcasts and other communications that will notify you of radiation levels and if animal feed growing in your area is considered harmful. As a precautionary measure, house the dairy animals and livestock and do not let them graze. In the event you have no stored feed during an emergency, you should know that animals could survive for a period of time on water alone.

State emergency personnel will be monitoring milk and milk stations, and sampling will also be done on the farms. When possible, you will be informed whether or not your milk contains radioactive materials.

Poultry

Measures for protecting poultry are the same as those recommended for other farm animals.

Poultry is somewhat more resistant to radiation than other farm animals. Also, most poultry is raised under shelter and given feed that has been protected or stored, so they are of less concern following a radiological emergency. However, the same measures recommended for livestock should be taken.

Animal Food Products

Do not destroy any animal food products unless spoilage has made them inedible. Milk should be safe to use if it is from dairy animals that have been adequately sheltered and protected. Livestock exposed to external contamination can be used for food if the radiation level is not excessive, if they are adequately washed and if monitored by state authorities prior to slaughtering. Meat animals who have internal contamination cannot be slaughtered until the owner is advised by the appropriate state authorities that it is safe to do so. You will receive specific instructions from state authorities.

If milk pickups and deliveries are interrupted because of an emergency, officials concerned will be in touch with milk transport companies and will provide instructions. There may be delays in pickups, which will necessitate the holding of milk for longer than normal periods. It is possible that some milk may have to be discarded.

Animal Health

It is unlikely that the type and level of radioactive release would cause any animal illness. Animals skins containing radioactive materials can be washed off with soap and water. When washing animals, protective clothing should be worn similar to that worn when applying pesticides.

Land and Crops

Radioactive particles may settle on soil and crops. If so:

- Farm workers may be unable to manage and cultivate land safely because of the possibility of external and internal contamination.
- It may not be advisable to permit animals to graze because of the danger of ingesting contaminants.
- Radioactive particles could cause surface contamination of all plants, resulting in potential hazard if they are consumed by human beings or animals.

Effect on Land

It is anticipated that most affected land could be returned to normal use in several weeks after having been contaminated. The exact length of time that the land would remain unusable would depend on the amount and type of radioactive materials deposited in a given area.

Extension agents and state agricultural officials will guide farmers in determining how to use their land following a radiological emergency.

Economics

Under the worst conditions, radioactive contamination could reduce the economic productivity of your farm. As previously mentioned, you may suffer the loss of some farm and dairy items due to spoilage during the period of time that a radiological emergency is in progress. However, following an accident, radioactive contamination might reduce the competitive economic value of your farm products. This would be due to public reluctance to purchase farm products that are suspected of having been grown in an area that has been affected by a radioactive release from a nuclear power plant or other source. State authorities will advise you on the contamination level that your farm experienced and the marketability of your farm products. An insurance pool has been established to help individuals recover from the losses caused by a radiological disaster.

Vegetables

When growing fruit and vegetables are exposed to heavy concentrations of radioactive particles, they can become externally contaminated. Leaves, pods and fruits that retain radioactive particles can be cleaned before being eaten. Washing is probably the most effective measure, just as it is the best way to clean garden foods that get dirty from other causes.

Roots and tubers absorb little contamination. The normal cleaning or peeling of underground vegetables such as potatoes and carrots would be adequate for removing contamination.

Fruits that are ripe at the time of a radiological accident may be lost due to a possible personal hazard to the worker. Fruits that do not have to be picked immediately can be saved and picked after the contamination has decayed.

Summary

The information contained in this pamphlet applies to all areas of the Commonwealth. Be familiar with the probable effect and potential effects of radiation contamination on your farming operation. If it should occur, listen for EBS messages on your local radio and television stations.

If you are warned that a radiological emergency exists, do the following:

- Arrange for the safety of you and your family.
- Shelter all farm animals, especially dairy cattle, and feed and water livestock from stored feed and protected water.
- Bring feed into building, or cover it if outdoors.
- Store as much water as possible for livestock. Cover wells, rain barrels and tanks.
- Delay grazing of animals on contaminated pasture.
- Place food or water in a closed area inside a house where it cannot be contaminated. Uncovered food brought in from a contaminated area should be cleaned. Eggs, potatoes, melons and root crops that are clean can be eaten. Green vegetables should be carefully washed and their outer layers removed if they were exposed to radiation. Peas and beans require normal cleaning.

You should protect yourself against radioactive contamination by:

- Washing hands thoroughly before you eat;
- Wearing protective clothing (such as that worn during pesticide applications) when working outdoors during the first few days following a release of radioactivity. Remove outer clothing before entering your home. If you are plowing or cultivating dry land, or if you are harvesting corn, wear a dust filter over your nose and mouth.

Governmental agencies will conduct assessments of land and crop damages and will advise you on how farm activities should be continued following a radiological accident.

If you desire to discuss this subject further or conduct a meeting in your community on this topic, contact your local Extension Office, any local USDA agency representative, your Emergency Coordinator or the Virginia Department of Agriculture and Consumer Services.

Appendix 1

Adjacent States and Jurisdictions Within 50-Mile Ingestion Pathway*

1. The Virginia Emergency Operations Center (EOC) will provide notification to affected or potentially affected jurisdictions within the ingestion pathway and adjacent states in the event of a radiological emergency occurring at the North Anna or Surry Power Stations.* The State will transmit to each local organization recommended protective measures based upon protective action guides and other criteria. This shall be consistent with the recommendations of the U.S. Environmental Protection Agency (EPA) regarding exposure resulting from passage of radiological airborne plumes and with other Federal recommendations regarding radioactive contamination of human foods and animal feeds.
2. The primary means for notifying adjacent states and local jurisdictions within ingestion pathway will be by commercial telephone. Virginia Criminal Information Network (VCIN) will be used to back up voice messages as appropriate. Adjacent states and local governments within the ingestion pathway are listed in Tables 1 (Surry) and 2 (North Anna).
3. The Virginia EOC will provide notification to affected or potentially affected local jurisdictions within the Virginia portion of the ingestion pathway in the event of a radiological emergency occurring at the Calvert Cliffs (Maryland) Nuclear Power Station. See Table 3 for jurisdictions to be notified.
4. Notifications will be made to local governments within the ingestion pathway when a General Emergency is declared or earlier as appropriate.

* Similar alerting procedures will be used to notify any area(s) of the state depending on the type of radiological accident and its effects.

Table 1 - Surry Power Station Ingestion Pathway Adjacent Jurisdictions
(In-State and Out-of-State)

Virginia Counties	Cities
1. Charles City	1. Chesapeake
2. Chesterfield +	2. Colonial Heights
3. Dinwiddie	3. Franklin
4. Essex +	4. Hampton
5. Gloucester	5. Hopewell
6. Hanover +	6. Newport News*
7. Henrico +	7. Norfolk
8. Isle of Wight *	8. Petersburg
9. James City *	9. Poquoson
10. King & Queen +	10. Portsmouth
11. King William +	11. Richmond +
12. Lancaster	12. Suffolk
13. Mathews	13. Virginia Beach
14. Middlesex	14. Williamsburg *
15. New Kent	
16. Northampton	
17. Northumberland	
18. Prince George	
19. Richmond	
20. Southampton	
21. Surry *	
22. Sussex	
23. York *	
North Carolina Counties	Cities
1. Camden	4. Currituck
2. Gates	5. Northampton
3. Hertford	6. Pasquotank

* Within 10 miles of Surry Power Station.

+ Also within 50 miles of North Anna Power Station.

Table 2 - North Anna Power Station Ingestion Pathway-Adjacent Jurisdictions
(In-State and Out-of-State)

Virginia Counties	Cities
1. Albemarle	1. Charlottesville
2. Amelia	2. Fredericksburg
3. Buckingham	3. Richmond +
4. Caroline *	
5. Chesterfield +	
6. Culpeper	
7. Cumberland	

8. Essex +
9. Fauquier
10. Fluvanna
11. Goochland
12. Greene
13. Hanover * +
14. Henrico +
15. King George
16. King & Queen +
17. King William +
18. Louisa *
19. Madison
20. Orange *
21. Page
22. Powhatan
23. Prince William
24. Rappahannock
25. Rockingham
26. Spotsylvania *
27. Stafford
28. Westmoreland

Maryland Counties

Cities

1. Charles

* Within 10 miles of North Anna Power Station.

+ Also within 50 miles of Surry Power Station.

Table 3 - Calvert Cliffs Power Station (Maryland)

Virginia Jurisdictions Within Ingestion Pathway

Virginia Counties

Cities

- | | |
|----------------------|-----------------|
| 1. Accomack | 1. Alexandria |
| 2. Arlington | 2. Falls Church |
| 3. Caroline * | |
| 4. Essex * | |
| 5. Fairfax | |
| 6. King George * | |
| 7. King & Queen | |
| 8. Lancaster | |
| 9. Middlesex | |
| 10. Northumberland | |
| 11. Prince William * | |
| 12. Richmond + | |
| 13. Stafford * | |
| 14. Westmoreland * | |

* Also within 50 miles of North Anna Power Station.

+ Also within 50 miles of Surry Power Station.

Source: Baltimore Gas and Electric Company, Calvert Cliffs Nuclear Power Plant, Units 1 and 2, Emergency Response Plan, as revised (12/3/86).

Appendix 2

Livestock Requirements

The following charts are extracted from ASAE (American Society of Agricultural Engineers) Standards 1986.

Water Requirements per Animal per Day*

Ample Supply		
Animal	Liters	Gallons
Cattle	64.0	17.0
Hogs	9.5	2.5
Sheep	5.8	1.5
Poultry		
-Layers and Broilers-	0.24	0.06
-Turkeys-	1.26	0.30
Limited Supply**		
Animal	Liters	Gallons
Cattle	26.5	7.0
Hogs	4.8	1.2
Sheep	3.8	1.0
Poultry		
-Layers and Broilers-	0.20	0.05
-Turkeys-	0.50	0.12

* Average requirements at a temperature of 27°C (80 °F)

** Water rationing facilities required

Limited Feed Requirements for livestock per day*

Animal	Feed	Amt.of Feed % of body wt.
Cow, lactating	hay	2
Cow, dry	hay	?
Calf, less than 9 mo.of age	hay	2
	40% protein supplement	0.2

Sheep, ewe	alfalfa hay	1
Sheep, lamb 27 kg. (60 lbs)	alfalfa hay	1.5
Sow, pregnant	corn	0.4
	35% protein supplement	0.2
Sow, lactating	corn	1
	35% protein supplement	0.2
Hog, 45kg. (100 lbs.)	corn	1.5
Hog, 91kg. (200 lbs.)	corn	1
Laying hen	mash	2
Turkey, 5 kg (10 lbs.)	mash	1.7
Turkey, 11 kg (25 lbs.)	mash	1.3

* Equivalent feeds may be substituted. Hay should be at least one-half legume or equivalent in protein content.

Limited Space for Animals in Fallout Shelters

Animal	Space per Animal	
	Sq. M.	Sq. Ft.
Cow	1.9	20
Calf	1.1	12
Sheep, ewe	0.93	10
Sheep, lamb 27 kg. (60 lbs)	0.37	4
Sow, lactating	3.0	32
Hog, 45kg. (100 lbs.)	0.37	4
Hog, 91kg. (200 lbs.)	0.56	6
Chicken	0.06	0.7
Turkey, 5 kg (10 lbs.)	0.14	1.5
Turkey, 11 kg (25 lbs.)	0.19	2

For more information, please contact the VDEM Public Affairs Office via e-mail at pio@vdem.virginia.gov, by phone at (804) 897-6510 or by mail:

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